Perspective

Sanitation Systems (/perspective/sanitation-systems-perspective)

Section

Sanitation Technologies (/sanitation-systems/sanitation-technologies)

Factsheet

Upflow Anaerobic Sludge Blanket Reactor (UASB)

العربية (/ar/sanitation-systems/sanitation-technologies/upflow-anaerobic-sludge-blanket-reactor-(uasb))

Applicable to

System 1 (/humanitarian-crises/rural-settings/sanitation/sanitation-systems/system-1%3A-single-pit-system)

System 6 (/humanitarian-crises/rural-settings/sanitation/sanitation-systems/system-6%3A-blackwater-treatment-system-with-infiltration)

System 7 (/humanitarian-crises/rural-settings/sanitation/sanitation-systems/system-7%3A-blackwater-treatment-system-with-effluent-transport)

System 8 (/humanitarian-crises/urban-settings/sanitation/sanitation-systems/system-8%3A-blackwater-

Application level

- [x] City
- [ ] Household
- [x] Neighborhood

Management level

- [ ] Household
- [x] Public
- [ ] Shared

Inputs

Blackwater

Brownwater

+ Greywater

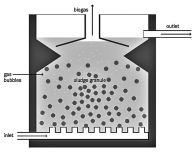
Outputs

Sludge

Effluent

Biogas

transport-to-%28semi-%29-centralized-treatment-system)
System 9 (/sanitation-systems/sanitation-systems/system-9%3A-sewerage-system-with-urine-diversion)



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Adapted from

Compendium of Sanitation Systems and Technologies. 2nd Revised Edition (/node/5587)

Executive Summary

The upflow anaerobic sludge blanket reactor (UASB) is a single tank process. Wastewater enters the reactor from the bottom, and flows upward. A suspended sludge blanket filters and treats the wastewater as the wastewater flows through it.

Advantages

- High reduction of BOD
- Can withstand high organic and hydraulic loading rates
- Low sludge production (and, thus, infrequent desludging required)
- Biogas can be used for energy (but usually first requires scrubbing)

Disadvantages

- Treatment may be unstable with variable hydraulic and organic loads
- Requires operation and maintenance by skilled personnel; difficult to maintain proper hydraulic conditions (upflow and settling rates must be balanced)
- Long start-up time to work at full capacity
- A constant source of electricity is required
- Not all parts and materials may be locally available
- Requires expert design and construction
- Effluent and sludge require further treatment and/or

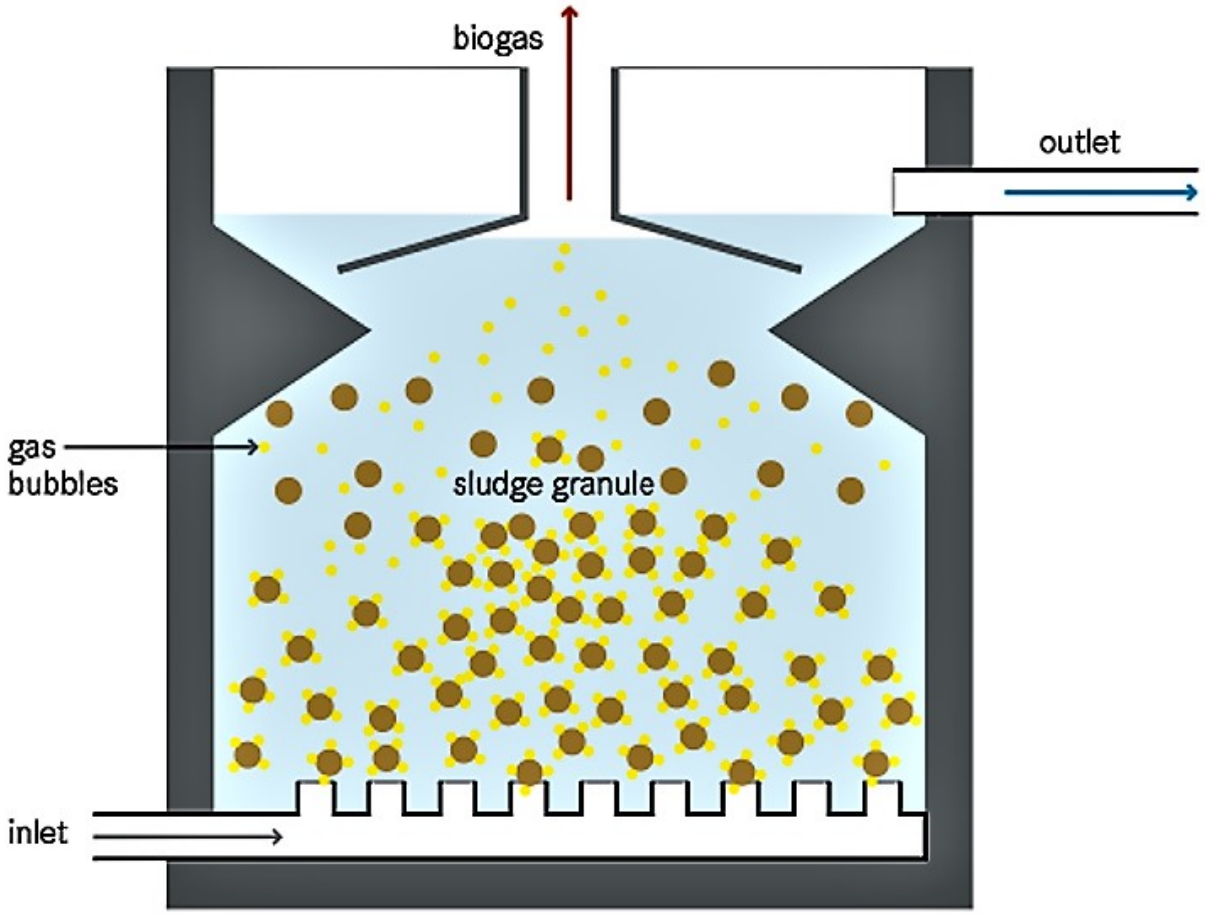
appropriate discharge

In	Out
Blackwater, Faecal Sludge, Brownwater, Faeces, Excreta	Digested Faecal Sludge, Fertigation Water

Introduction

The sludge blanket is comprised of microbial granules (1 to 3 mm in diameter), i.e., small agglomerations of microorganisms that, because of their weight, resist being washed out in the upflow. The microorganisms in the sludge layer degrade organic compounds. As a result, gases (methane and carbon dioxide) are released. The rising bubbles mix the sludge without the assistance of any mechanical parts. Sloped walls deflect material that reaches the top of the tank downwards. The clarified effluent is extracted from the top of the tank in an area above the sloped walls.

After several weeks of use, larger granules of sludge form which, in turn, act as filters for smaller particles as the effluent rises through the cushion of sludge. Because of the upflow regime, granule-forming organisms are preferentially accumulated as the others are washed out.



Cross-section of an Upflow Anaerobic Sludge Blanket (UASB) reactor. Source: TILLEY et al. (2014)

Design Considerations

Critical elements for the design of UASB reactors are the influent distribution system, the gas-solids separator, and the effluent withdrawal design. The gas that rises to the top is collected in a gas collection dome and can be used as energy (see also **use of biogas (/factsheet/direct-use-of-biogas)**). An upflow velocity of 0.7 to 1 m/h must be maintained to keep the sludge blanket in suspension. Primary settling is usually not required before the UASB.

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Health Aspects/Acceptance

The operators should take proper health and safety measures while working in the plant, such as adequate protective clothing. Effluent and sludge still pose a health risk and should not be directly handled.

Operation & Maintenance

The UASB is a Centralized Treatment technology that must be operated and maintained by professionals. A skilled operator is required to monitor the reactor and repair parts, e.g., pumps, in case of problems.

Desludging is infrequent and only excess sludge is removed every 2 to 3 years.

Applicability

A UASB is not appropriate for small or rural communities without a constant water supply or electricity. The technology is relatively simple to design and build, but developing the granulated sludge may take several months. The UASB reactor has the potential to produce higher quality effluent than **Septic Tanks (/factsheet/septic-tank)**, and can do so in a smaller reactor volume. Although it is a well-established process for large-scale industrial wastewater treatment and high organic loading rates up to 10 kg BOD/m3/d, its application to domestic sewage is still relatively new. It is often used for brewery, distillery, food processing and pulp and paper waste since the process typically removes 80 to 90% of COD. Where the influent is low-strength or where it contains too many

solids, proteins or fats, the reactor may not work properly. Temperature is also a key factor affecting the performance.

Library References

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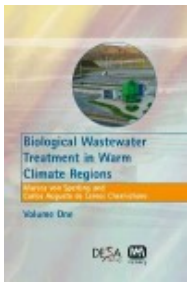
Biological Wastewater Treatment in Warm Climate Regions Volume 1



Biological Wastewater Treatment in Warm Climate Regions gives a state-of-the-art presentation of the science and technology of biological wastewater treatment, particularly domestic sewage. The book covers the main treatment processes used worldwide with wastewater treatment in warm climate regions given a particular emphasis where simple, affordable and sustainable solutions are required. The 55 chapters are divided into 7 parts over two volumes: Volume One: (1) Introduction to wastewater characteristics, treatment and disposal; (2) Basic principles of wastewater treatment; (3) Stabilisation ponds; (4) Anaerobic reactors; Volume Two (also available in the SSWM library): (5) Activated sludge; (6) Aerobic biofilm reactors; (7) Sludge treatment and disposal.

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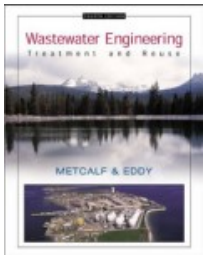

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